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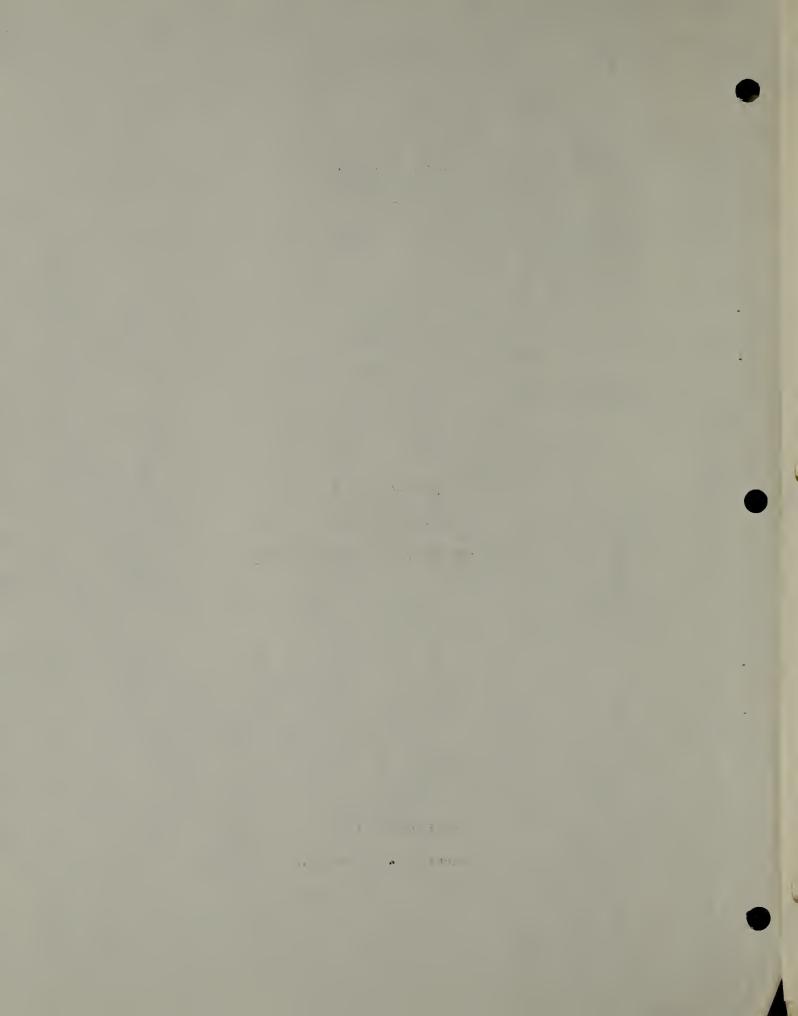
Senior High School
Curriculum Guide
VOCATIONAL SERIES

Electricity 12 and Electronics 22

(Interim Edition, September 1963)

Province of Alberta

Department of Education



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COURSE CREDIT VALUES

Electricity	12	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٩	5 credits
Electronics	22	•	•	•	•	•		•	•	٠	•	•	•	•	•	•	15 credits
Electronics	32	•		•		•		•	•		•			•	•	•	15 or 20 credits

One credit corresponds to a minimum of 40 minutes of instruction time per week.

FOREWORD

In this age of missiles, rockets, satellites and space capsules, there seems to be little doubt that we have arrived at the threshold of conquering space. There have been few scientific achievements that have received the acclaim given to the recent advances in this field. Much of the success achieved was dependent upon success in a closely related field - the field of electronics.

Electronics has played and continues to play an ever increasing role in industry, particularly in the field of automation. More and more industries are employing electronic devices of one sort or another.

Although schools, colleges and industry are training more and more electronic technicians, the number of competent technicians is insufficient for the proper maintenance of newly developed electronic equipment. There is no doubt that many openings exist and will continue to develop in the future, for those who are interested in making a career of electronics.

GENERAL OBJECTIVES

- 1. To impart to the student a knowledge of the role that electricity and electronics play in industry today, and the opportunities that exist in this rapidly expanding field.
- 2. To equip the student with sufficient skill and knowledge such that he will be highly employable in the electrical or electronics field.
- 3. To provide the student with sufficient background such that on entering the apprenticeship program, he will be able to advance at an accelerated rate on the basis of his proven ability on the job.
- 4. To prepare a student to a degree of competency acceptable to the Institutes of Technology sufficient for entry into the second year of the Electronic Technology program.

GENERAL INFORMATION

1. Course Credit Values

Electricity 12 - 5 credits.

Electronics 22 - 15 credits.

Electronics 32 - 15 or 20 credits.

NOTE: Electricity 12 is also the prerequisite for Electricity 22.

2. Safety Program

Every shop must have an effective safety program. In the electronics shop particular attention must be given to the safety measures required in the industry: adequate guards; cleanliness of shop and personnel maintained at a high standard; students properly clothed for their work; etc. The shop organization must be such as to ensure stressing this very important phase of the shop program.

A good safety program features the following devices: regular, consistent and thorough instruction; constant vigilance and checking by the instructor; safety posters; student safety committee; adequate first aid equipment; instructor trained and up-to-date in first aid methods; dynamic color painting of machines and equipment; adequate working space about machines; safety

NOTE: Electronics 32 will be forwarded as soon as the outline has been prepared.

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lines on floor around machines; routine report on accidents however minor; machines and tools in approved working condition; a safety conscious group of students and instructor.

3. Instructor's Records

The instructor should keep accurate records of:

- (a) Student enrolment and attendance
- (b) Student accounts
- (c) Student work activity
- (d) Theory covered
- (e) Tests given
- (f) Student achievement
- (g) Up-to-date inventory of all equipment

4. Students! Records

Instructors should ensure that students develop and maintain a neat and accurate record of:

- (a) Notes on theory
- (b) Daily shop activities (time cards)

5. Enrolment

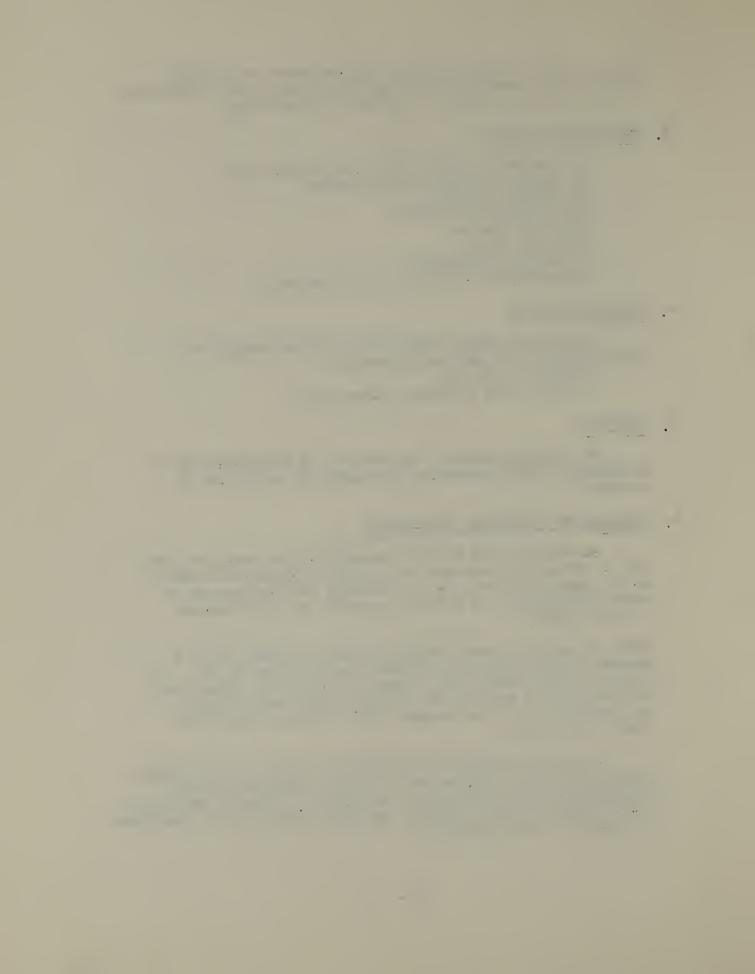
The maximum enrolment recommended for Electricity 12 is 20 students. The maximums for Electronics 22 and 32 are 15 students.

6. Guidance and Vocational Information

Instructors must assume responsibility in their own trade area to ensure that students and guidance officials are aware of the local situation. It is essential that instructors be active, interested and informed regarding the opportunities in their field.

NOTE: In order to permit students from an academic Grade X program to cross over into the vocational program at the Grade XI level, schools may combine the 12 and 22 courses into one course for a total of 20 credits. Where these courses are combined, it is recommended that students purchase the Grade XI text only.

It should be clearly understood that success in the fields of electricity and electronics is largely dependent upon the students ability in mathematics and science. Students possessing a "C" standing in these subjects generally should not be encouraged to register in these courses.



Whereas the Electricity 12 course is an exploratory course open to all Grade X students, Electronics 22 and 32 are definitely vocational and only those students who have displayed ability and aptitude for the program should be encouraged to continue. It is not in the best interests of the student to permit him to continue in a program which demands a large portion of his school time, and in which the instructor and/or guidance counsellor feel that he has little chance of success.

OBJECTIVES FOR ELECTRICITY 12

- 1. To provide exploratory experiences in the fields of electricity and electronics.
- 2. To acquaint students with the opportunities for employment in the electrical and electronics fields.
- 3. To provide the necessary background for Electricty 22 and Electronics 22.

TEXT: UNDERSTANDING ELECTRICITY AND ELECTRONICS by Buban and Schmitt, McGraw-Hill Book Company.

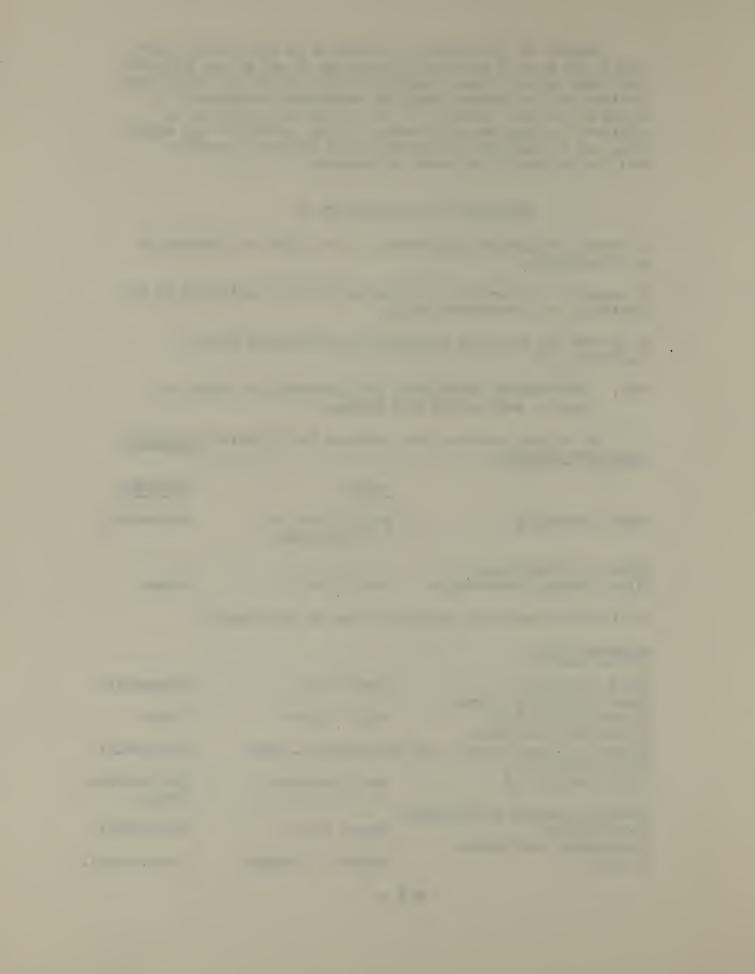
In addition students must purchase the following Laboratory Experiment Manuals:

	Author	Publisher
Basic Electricity	Paul B. Zbar and S. Schildkraut	McGraw-Hill
Laboratory Experiments, Direct Current Fundamentals	John R. Duff	De l mar

The following reference texts should be in the library:

Reference Texts

Basic Electronics -	Bernard Grob	McGraw-Hill
Basic Electricity, Direct Current Fundamentals Industrial Electricity	Orla E. Loper	Delmar
Volume I, Direct Current (3	3rd Ed) Chester L. Daves	McGraw-Hill
Basic Electricity, Part I and Part II	Van Valkenburgh	The Technical Press
Electric Circuits and Machi Third Edition Introduction to Electric	nes, Eugene Lister	McGraw-Hill
Circuits	Herbert W. Jackson	Prentice-Hall



INSTRUCTIONS ON THE USE OF THE FOLLOWING OUTLINE

The course outline is divided into three columns designated: Basic Information, Operations and Projects and References. The first column refers to the essential knowledge required. The second column outlines the activities to be performed by the students in the laboratory or shop. The third column is a guide to assist the instructor in locating the topics in the text. It is intended that this column also be used to indicate the supplementary references other than the text, deemed necessary to fill in topics where the text is inadequate. Instructors are requested to insert references which they consider to be most suitable for the particular topics outlined. It would be desirable if instructors would also note the time spent on the various units. This information will be extremely valuable to the curriculum committee in revising this outline. We ask that instructors keep two copies of this guide, one which can be returned to the Department with the instructors' notations as mentioned above, and one for their own records.

The time for each unit is noted and should be adhered to as closely as possible to ensure coverage of the entire course. There will be overlapping of theory into the laboratory which will have the effect of increasing the actual time devoted to the unit. It is estimated that on the average, two hours will be required to complete each experiment.

Timetables should be arranged so that this amount of time is available in a block so that the experiments may be completed and thus free the equipment for use by the next class.

Instructors must emphasize correct technique, correct tools and the development of skill with basic hand tools.

SPECIAL NOTE TO INSTRUCTORS

Substitute V.O.M.'s for V.T.V.M.'s in all experiment from Zbar and Schildkraut up to # 24 where applicable.

REFERENCE CODE FOR THE ELECTRONICS COURSE

- B/S Understanding Electricity and Electronics Buban & Schmitt
- G Basic Electronics Grob
- J Introduction to Electric Circuits Jackson
- R.A.H. Radio Amateur's Handbook American Radio Relay League
- G/K Applications of Electronics Grob & Kiver

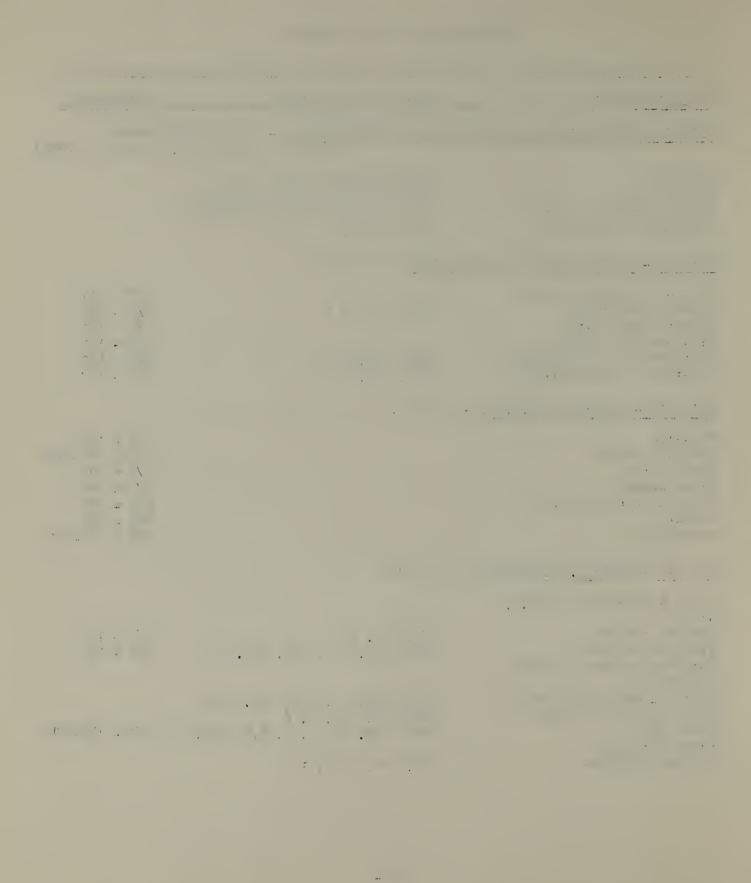
REFERENCES (code)

- P Perensky, Electronic Instrumentation, Prentice-Hall
- U Cathode Ray Tubes & Their Associated Circuits U.S. Government Printing Office
- US Theory & Use of Electronic Test Equipment U.S. Government Printing Office
- S Stout, Basic Electrical Measurements Prentice-Hall
- N Notes, Southern Alberta Institute of Technology
- NI Notes to be provided by the instructor
- ML Marcus & Levy, Practical Radio Servicing, second edition, McGraw-Hill

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Basic Information	Operations & Projects	References
Unit I - Opportunities in Elect	ricity and Electronics - 4 hours (Re 2 hours in September,	
Engineers Technicians Related Fields - training, employment and future.	Familiarization tour of the laboratory or shop to acquaint the class with shop procedure and routine.	
Unit II - Basic Concepts of Ele	ctricity - 20 hours	
Electron theory of matter Static electricity Dynamic electricity Electromotive force	Duff, Exp. # 1	B/S - 117 B/S - 118 B/S - 121 B/S - 123
Resistance and conductance Insulators and conductors	Duff, Exp. # 6 Duff, Exp. # 7	B/S - 132 B/S - 127
Unit III - Sources of E.M. F	4 hours.	
Friction Chemical action Heat action Light action Pressure (piezo-electric effect) Mechanical		B/S - 118 B/S - 208-215 B/S - 231 B/S - 228 B/S - 231 B/S - 231 B/S - 231
Unit IV - Basic D. C. Circuits	- 25 hours	
Basic components of a D.C. circuit Series circuits Parallel circuits Switches - types and their application	Z/S, Exp. # 8 Duff, Exp. # 4, Z/S, Exp. #9	B/S - 146 B/S - 147
Series - parallel circuits Use and Care of Meters Ohm's Law Kirchoff's Law	Duff, Exp.# 5, Z/S, Exp. # 10 Z/S, Exp. # 4, 5, 6 Duff, Exp. #2, 3, 8, Z/S, Exp. #	7 ⁻ B / S - 1 44 -1 54
Voltage Dividers	Z/S, Exp. # 12, 13	



Basic Information	Operations & Projects	References
Unit V - Magnetism and Electromag	gnetism - 13 hours	
History of magnetism		
Natural and artificial magnets Magnetic poles Magnetic fields Laws of Attraction and Repulsion	Duff From #Oc	B/S - 164 B/S - 165
Magnetic field strength	Duil, 15xp. #98	B/S -171, 172
Magnetic field around a current- carrying conductor The solenoid and electromagnet Applications of electromagnets		B/S - 171 B/S - 173
Unit VI - D.C. Measuring Instrume	ents - 8 hours (introduction)	
The D'Arsonval Movement The D'Arsonval as a voltmeter The D'Arsonval as an ammeter V.O.M. and V.T.V.M. Measuring Resistance	Z/S, Exp. 14 Z/S, Exp. 15 Z/S, Exp. 17	B/S - 238 B/S - 240-241 B/S - 239 B/S - 244
- voltmeter - ammeter method - ohmmeter - wheatstone bridge Wattmeter and Watthour meter	Z/S, Exp. 16	B/S - 242 B/S - 252

ELECTRONICS 22 - 15 credits

Title Author Publisher Texts BASIC ELECTRONICS Pernard Grob McGraw-Hill APPLICATIONS OF ELECTRONICS Grob & Kiver McGraw-Hill The following laboratory manuals must be purchased by the students: BASIC ELECTRICITY Zbar & Schildkraut McGraw-Hill (This manual was purchased for Electricity 12 so that students should be in possession of this book already) BASIC ELECTRONICS Zbar & Schildkraut McGraw-Hill RADIO AMATEUR'S HANDBOOK American Radio Relay League R.C.A. Tube Manual REFERENCES The following references should be in the electronics library: FUNDAMENTALS OF ELECTRONICS E. Norman Lurch Wiley (General Publishing Company) DICTIONARY OF ELECTRONIC TERMS Allied Radio INTRODUCTION TO ELECTRIC Prentice-Hall CIRCUITS Jackson BASIC THEORY AND APPLICATION OF TRANSISTORS U.S. Army - Superintendent of Documents, Washington, D.C. RAYTHION TUBE MANUALS or equivalent - 3 volumes 1. Entertainment tubes 2. Transistors 3. Transmitter tubes RADIO COLLEGE OF CANADA Service Manuals (post 1950) P - Perensky, ELECTRONIC INSTRUMENTATION, Prentice-Hall U - CATHODE RAY TUBES & THEIR ASSOCIATED CIRCUITS - U.S. Government Printing Office US - THEORY & USE OF ELECTRONIC TEST EQUIPMENT - U.S. Government Printing Office S - Stout - BASIC LLECTRICAL MEASURLMENTS - Prentice-Hall

McGraw-Hill

ML - Marcus & Levy - PRACTICAL RADIO SERVICING - second edition.

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ELECTRONICS 22 COURSE OUTLINE

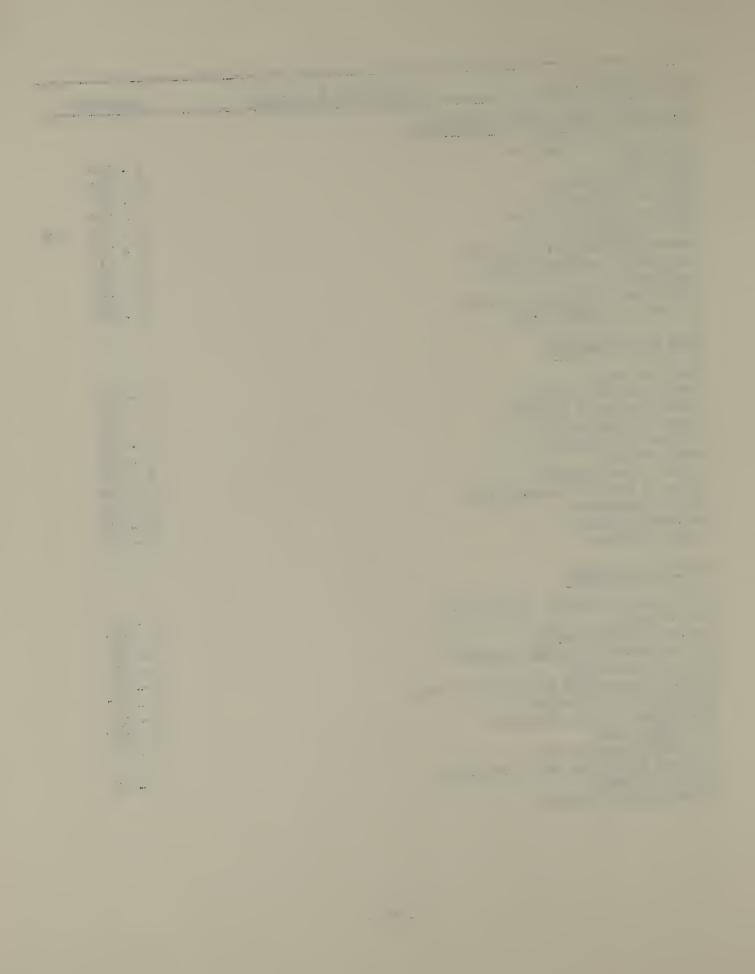
Basic Information	Operations & Projects	References
Jnit I - Introduction		
Thy study electronics		
Always be careful		
Color codes		G-126,298,503-
Symbols & abbreviations		505
Charts & tables		G-506-509 J-4
- frequency spectrum - resistivity		R.A.H 17
- conversion factors		J - 41
- dielectric constants		J - 220
- construction practices		0 220
- vacuum tube data		Tube Manual
- semi-conductor data		Transistor
Methods of communication		Manual
History of communication		
Elementary wave theory		
Init II - Electron Theory		
Parts of an atom		G - 9
Positive & negative charge		G - 12
Law of electrostatics		G - 13
Elements		G - 11
Compounds & molecules		B/S - 117
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Jnit III Electricity		
Static electricity		G - 12, 18
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Coulomb's law		
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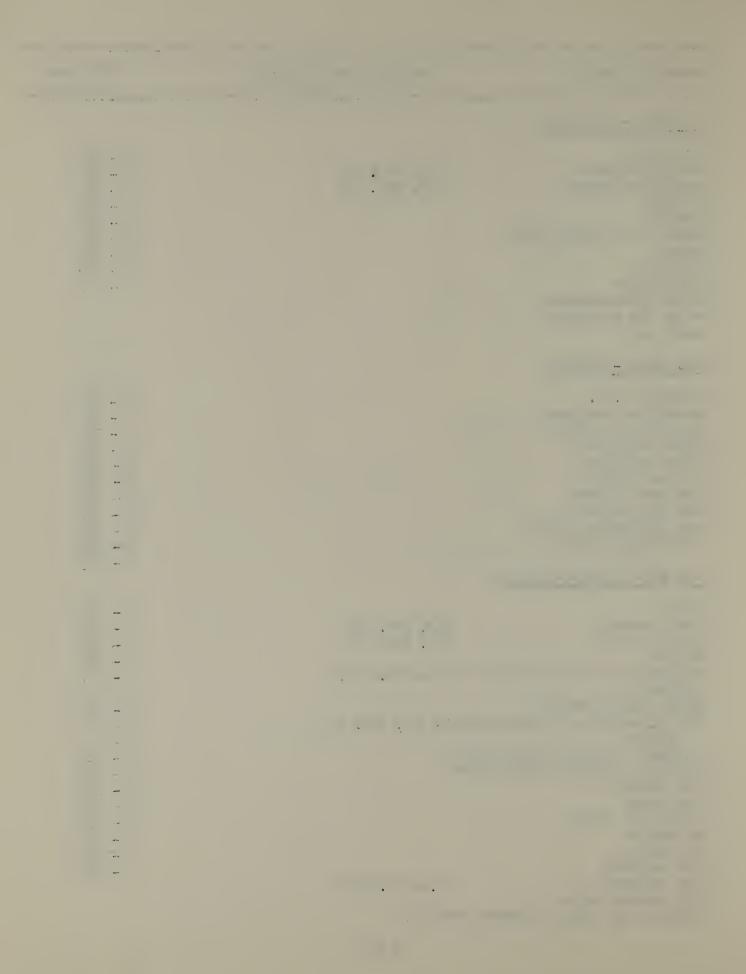
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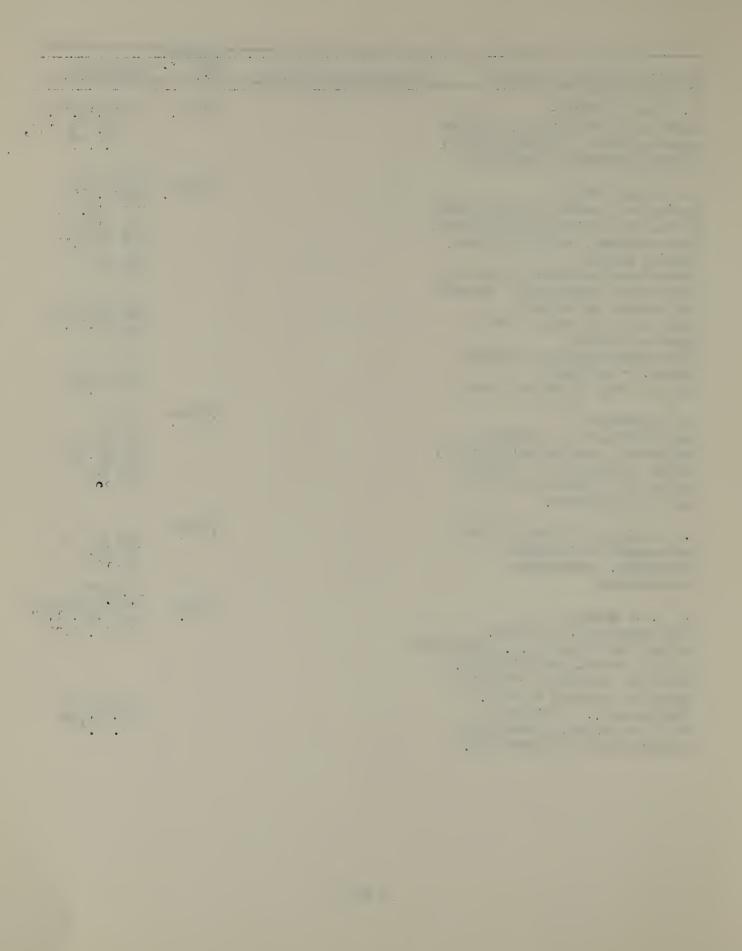
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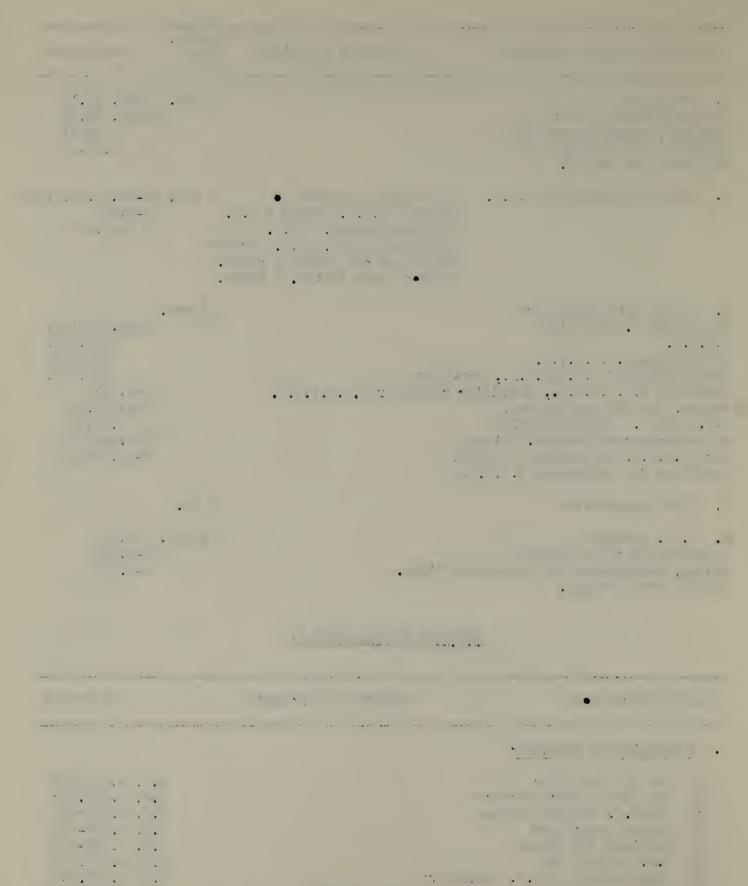
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	On which the Control of the Control	Approx.	7
Detailed Outline, Lectures	Operations & Projects	Time	References
1. Types of Meters Basic meter principles, electro- magnetic meters, thermal meters, electrodynamometer (wattmeter)		1½ hr.	PP 10,11,12, 13. US 1,2,1 3,4,5,6
2. Current Meters Moving coil meters, introduction, Mechanics of D'Arsonval movement, motor systems, control systems, damping system Meter characteristics, internal resistance, sensitivity, accuracy		나를 hrs.	PP 15, 16 USP 16,17, 18 USP 9,10,11 USP 11
and sources of errors Basic ammeter, shunt formual, types of shunts Multirange ammeters, multiple shunts, ring shunts Use and care of current meters			USP 16,17,18 PP 15 USP 20,21
obe aim care of current he ters			001 20,21
3. Voltmeters Basic voltmeter, multirange voltmeter, separate multipliers, series multipliers. Loading effect of voltmeters, use and care of voltmeters.		1½ hr.	PP 14 USP 14, 15 PP 22, 23 USP 29
4. Conclusion of Meter Theory		l½hr.	
Measurement of internal resistance, temperature compensation		T ³ uT •	USP 11, 17 SP 418 N
5. A.C. Meters Low frequency A.C. meters, moving vane meters, A.C. conversi of D.C. meters, rectification,	on	l½hr.	1.15.26 PP 29,30,31,32 USP 30,31,32
types of rectifiers, rectifier circuits, sources of error.			
Thermocouple. Review of basic principles, temperature compensation of thermocouple.			USP.81, 83 N 1.15.29



Detailed Outline, Lectures	Operations & Projects	Approx. Time	References
6. Ohmmeters Series ohmmeter, shunt ohmmeter, potentiometer type ohmmeter, use and care of ohmmeter, the megger.		$1\frac{1}{2}$ hr.	P-pp. 18,19 US-pp. 34,35 36,37 N 1.15.15
7. Study of Commercial V.O.M.	The student is asked to design a V.O.M. having 2 D.O. voltmeter ranges, 2 A.C. voltmeter ranges, 2D.C. curranges and one ohmmeter range Homework time approx. 5 hour	cent	US-pp.54,55,57,56 P-p.21 N 1.15.22
8. Vacuum Tube Voltmeters Introduction. Elementary V.T.V.M. Bridge type D.C.V.T.V.M. Introduction of A.C.V.T.V.M., Recamplifier A.C.V.T.V.M., Amplifier Probes, Peak to peak probes, D.C. probes. Ohmmeterportion of electronic multimeter. Slide back V.T.V.M. Computation of inpuresistors for multirange V.T.V.M.	r rectifier A.C.V.T.V.M.	Ц <mark>2</mark> hrs	P-pp.121,122, 123,127, 128,129, 137,138, US-p. 49' P-p.130,131 N 1.15.35 US-p.44-45 P-pp.250-251
9. Term Examination		l hr.	
10. D. C. Bridges Introduction of wheatstone bridge, mathematics of wheatstone Kelvin double bridge.	e bridge.	l½ hrs	• P-p•46 US-p•122 S-p•84
RE	CEIVER THEORY (PART I)		
Basic Information	Operations & Projects		References

Pr	inciples of Receivers			
(a) (b) (c) (d) (e) (f) (g) (h)	The TRF amplifier Receiver characteristics The R.F. tuning circuit Tuning capacitors Multiple TRF stages R.F. selectivity Regeneration in R.F. amplifiers A.M. detectors	z/s,	Exp.#47	G.K. p.296-298 G.K. p.298,299 G.K. p.299-302 G.K. p.302-304 G.K. p.304-306 G.K. p.306;307 G.K. p.307,308 G.K. p.308-312
(i) (j)	Volume controls A TRF receiver			G.K. p.312-315 G.K. p.315-317
(k)	B. supply line			G.K. p.317-319



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Basic	Information	

Operations & Projects

References

2. The Superheterodyne Receiver

(a)	How the superheterodyne operates	Use demonstrator	G.K. p.322-325
(b)	Advantages	such as Philco or R.C.A.	G.K. p.325,326
(c)	Heterodyning		G.K. p.326-329
(d)	Effect of heterodyning on the sign	al	G.K. p.329,330
(e)	Converter circuits		G.K. p.330-334
(f)	Local oscillator	Z /S, Exp. #49	G.K. p.334-337
(g)	Spurious responses		G.K. p.337,338
(h)	I.F. amplifier		G.K. p.338,342
(i)	Automatic volume control		G.K. p.342-345
(j)	Typical receiver		G.K. p.348-352

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TEXTS:

- (1) Practical Radio Servicing by Marcus & Levy McGraw-Hill
- Theory and Use of Electronic Test Equipment, published by U.S. Government Printing Office, Washington 25, D.C.
- Students will require the texts authorized for Electronics 22 in addition to the above.

LABORATORY MANUALS:

The following laboratory manuals must be purchased by the students:

- (1) Basic Electronics by Zbar and Schildkraut, McGraw-Hill. (This manual was purchased for Electronics 22 so that it should be in the possession of the students now.)
- (2) Basic Radio by Zbar and Schildkraut; McGraw-Hill.

REFERENCES:

The following references should be available in the library in addition to those previously listed.

CODE

- Basic Television by Bernard Grob (3rd ed.) McGraw-Hill - Applications of Electronics, Grob & Kiver, McGraw-Hill - Practical Radio Servicing (First ed.), McGraw-Hill

R. C. A. - R. C. A. Receiving Tube Manual

R. A. H. - Radio Amateur's Handbook

- Instructor's Notes N

ELECTRONICS 32 UNITS AND SUGGESTED TIME:

1. Receiver Theory - 90 hours

Transmission Theory - 30 hours

3. Instrument Theory - 60 hours

Introduction to Television - 60 hours

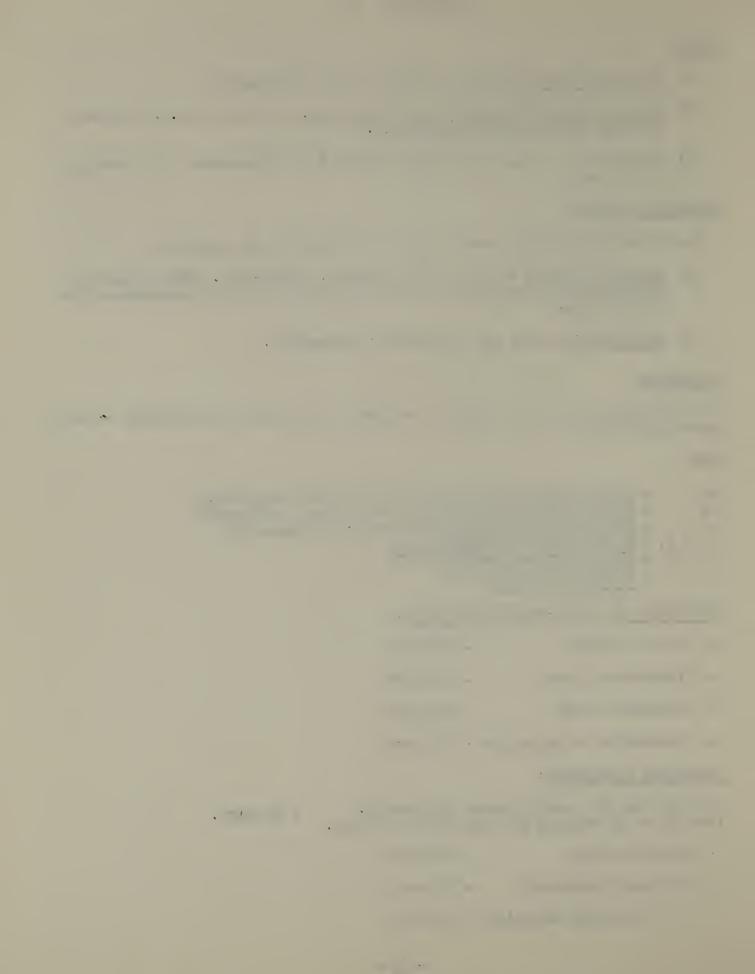
LABORATORY EXPERIMENTS:

Jobs #47, 49, 50, from Z/S Basic Electronics. - 94 hours. Jobs #51 to 75 omitting 64, from Z/S Basic Radio.

- 36 hours 5. Radio Servicing

Instrument Laboratory - 10 hours

To V. Servicing Laboratory - 20 hours



NOTE:

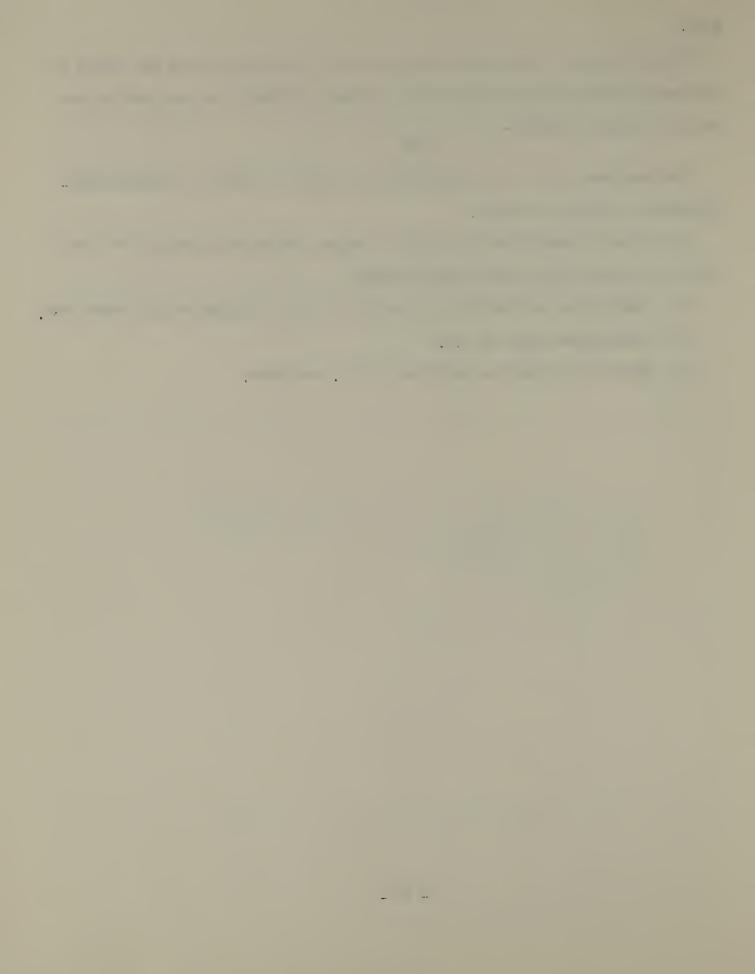
Schools wishing to offer Electronics 32 for 20 credits will have the choice of developing additional units based on the equipment available and the interest and ability of their students -

or

Devoting more time to the required course content to ensure a thorough understanding of the basis concepts.

The following suggestions are given for those instructors offering "32" for 20 credits, and who wish to cover more material:

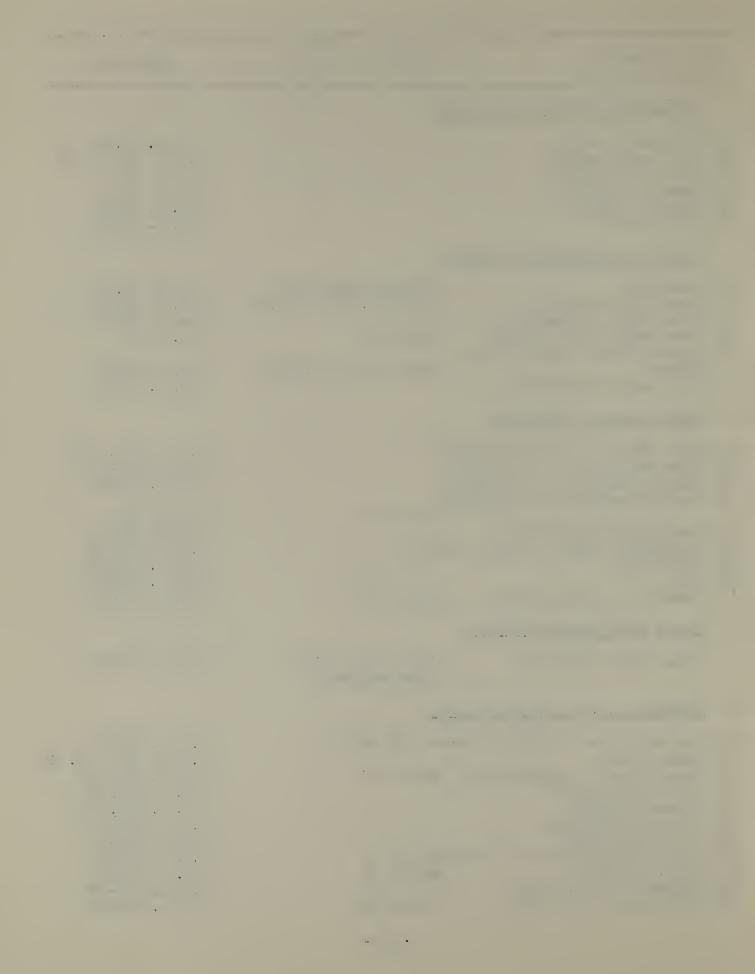
- (1) Complete as much material as possible in Basic Electronics by Bernard Grob.
- (2) Develop more depth in F.M.
- (3) Additional theory and servicing of T.V. receivers.



Basic Information	Operations & Projects	References
1. Frequency Modulation (Receivers) (a) The F. M. signal. Advantages	Use demonstrator such as Philco or R.C.A.	G. W 03 (. 000
and disadvantages. (b) A.M F.M. receivers (c) Limiters (d) Detectors		G.K. p.216-222 G.K. p.373-379 G.K. p.379-382
i. Ratio detector ii. Gated beam detector iii. Discriminators (note i and ii will be discussed more fully in T.V. theory)	To be discussed in T.V. Theory	RCA. p.43,44 G.K. p.384, 385 RCA p.43, G.K. pp. 282-284
(e) Triple-tuned discriminator(f) Phase shift discriminator(g) Automatic frequency control		G.K. p.382-384 N. N.
2. Preparing for Success in Troubles	shooting	
 (a) How you learn (b) Troubleshooting (c) Importance of test procedures (d) Professional servicing procedure (e) The customers complaint (f) Asking questions 		M.L. p.2 M.L. p.3 M.L. p.4,5 M.L. p.5 M.L. p.5,6 M.L. p.6,7
 (g) Confirming the complaint (h) Looking for clues (i) Types of complaint (j) The place of "Know How" and Expension (k) Performing tests (l) The air check 	Z & S Job 59 Z & S Job 62 erience	M.L. p.7 M.L. p.7,8 M.L. p.8 M.L. p.9,10 M.L. p.10 M.L. p.11
3. How the A. C D. C. Power Suppl	Ly Operates	
 (a) Heator supply for a 1-tube, 2-tube and 5-tube receivers (b) Position of tubes in the heater circuit 	Z & S Job 60	M.L. p.28-30 M.L. p.30,31
(c) The dial lamp (d) How plate supply is connected to the output stage	o	M.L. p.31 M.L. p.31,32,37,38
(e) Additional filters (f) Standard A. C D. C. power sup (g) Operation on a D. C. line (h) Floating chassis (i) Circuit of older A. C D. C. p (j) Test points and tests		M.L. p.40, 41 M.L. p.41, 42 M.L. p.42 M.L. p.43 M.L. p.43, 44

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В	asic Information	Operation & Projects	Ref	erences
4.	Servicing the Heater Power Sup	ply		
(b) (c) (d)	Preliminary check Tube socket tracing Systematic checking Ohmmeter checking Voltmeter checks Intermittents		M.L. p. M.L. p. M.L. p. M.L. p. M.L. p.	48, 49, 50 51 51-60 51-60
5.	Servicing the Plate Power Suppl	Ā		
(b) (c) (d)	Rectifiers Input Filter capacitors Output filter capacitors Power supply short circuits Printed circuit tracing tech-	Use demonstrator such as Philco, RCA or Welch Z&S Job 64	M.L. p. M.L. p. M.L. p. M.L. p.	64-71 71-75 75
(f)	niques Power supply variations	Refer to Jobs 34,35,36	M.L. p. M.L. p.	
6.	Audio Frequency Amplifiers			
(b) (c)	Quick check of an audio amplifi Quick check with a volt ohmmete Voltage analysis of an amplifie Ohmmeter analysis of an amplifi	er er	M.L. p.	129, 130 130-134 141-143
(e) (f) (g) (h)	Checking Coupling circuits Testing and repair of volume co Distortion Hum	Z&S Job 55 ntrols	M.L. p. M.L. p.	143 148–156 156–161 161–166 166–167
(i)	Variation in audio circuits	Z&S Job 56		173-211
7.	How to use a Signal Generator			
	(Home Study Assignment)	Give a short quiz to check assignment	M.L. p.	212-223
8.	Servicing I.F. and Detector Sta	ges		
(e) (f) (g) (h) (i) (j)	Test points for preliminary che Signal checks Output meters; Standard output Use of output meters Voltage analysis Resistance analysis I.F. transformers Repair and replacement of trans A.V.C. circuits Alignment of I.F. stages Variations in I.F. stages	Z&S Job 57 formers Z&S Job 52	M.L. p.	249-250 250, 251, 2 52 252, 253 253,254 257, 258 258-265 265-270 270-273 273-275 275-280 280-288



В	asic Information	Operations and Projects	References
9.	Servicing Converters		
(a) (b) (c) (d) (e)	Preliminary checking procedures Voltage analysis of converters Resistance analysis of converters Converter and oscillator tubes Gang tuning capacitors	Z&S Job 54	M.L. p.310,313 M.L. p.313-315 M.L. p.313-315 M.L. p.315 M.L. p.317-319
(f) (g) (h) (i)	Oscillator coils Variations in converter stages R. F. stages Loop antennas	Z&S Job 58	M.L. p.319 M.L. p.324-327 M.L. p.331-336 M.L. p.336-340
(j)	Alignment of front end	Z&S Job 63	M.L. P.336
10.	Servicing Transformer Type Power Sup	pplies	
(a) (b) (c) (d) (e) (f)	Preliminary checks Servicing heater supply Procedure for checking shorts Hum, squeals and motor boating Typical power supplies Variations in power supplies	Refer Z&S Job 34,35,36	M.L. p.348 M.L. p.349,350 M.L. p.350,351 M.L. p.352 M.L. p.355-359 M.L. p.359-363
11.	Servicing Transistor Portables		
(a) (b) (c) (d) (e) (f) (g)	Transistor amplifiers Circuit characteristics Bias Stabilizing circuits Temperature sensitive elements Signal feedback Basic transistor receivers	Use demonstrator such as Philco or RCA	M.L. p.364-368 M.L. p.368,369 M.L. p.369-371 M.L. p.371,372,373 M.L. p.373 M.L. p.374 M.L. p.375-378
(h) (i) (j)	Audio power amplifiers General servicing procedure Power supplies	Z&S Job 75	M.L. p.379;380 M.L. p.380,381 M.L. p.381-383
(k) (1) (m) (n)	Signal tracing methods Voltage analysis Servicing techniques Transistor testing	Z&S Job 74	M.L. p.383,384 M.L. p.384,385 M.L. p.385,386 M.L. p.387,388
(a) (p)	Alignment Practical circuits	Z&S Job 73	M.L. p.388,389 M.L. p.389-398

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Basic Informat	TON.

(v) The FM Antenna

Operations & Projects

References

M.L. 460,N.

12.	Servicing Auto Radios		
(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)	Types of auto radios Hybrid auto radios Input circuits Transistor output section Power supplies Trouble shooting procedures Alignment Auto noise suppression Circuit variations Vibrator circuits	Job 65	M.L. p.399 M.L. p.399-403 M.L. p.403,404 M.L. p.404,405 M.L. p.406,407 M.L. p.407,410 M.L. p.410-412 M.L. p.412-414 M.L. p.412-422 M.L. p.422,423
13.	Servicing F.M. Radios		,
(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (n) (o) (p) (q) (r) (t) (u)		portion should ive close attention	M.L. p.430,432,459,460 M.L. p. 432 M.L. p.433,458 M.L. 434,436 M.L. 436,438,456 M.L. 438 M.L. 439,441 M.L. 441 M.L. 441 M.L. 4443 M.L. 4444 M.L. 4446,448 M.L. 4449,451 M.L. 4451,452 M.L. 453 M.L. 453 M.L. 4554 M.L. 455
	NOTE: FM Multiplex will be cove technical detail in Audio		

Basi	c Information	Operations & Projects	References
(w) (x) (y)	Checking Voltages Tracing Unwanted Oscillation Switch Troubles Replacement Precautions	as	M.L.,p460,462 M.L. p.462 M.L. p.463 M.L. p.463
(aa) (ab) (ac)	Common troubles in FM Sets Alignment of FM Receivers Location of Alignment Adjustments	Z&S Job 70 Z&S Job 71	M.L. p.463 M.L.p.463,465 M.L. p.465,466
(ad) (ae) (af)	Methods Meter Method Limiter-discriminator type - Alignment Oscillator and RF Alignment	· IF Z&S Jeb 69	M.L. p.467 M.L. p.467,468 M.L. p.469,472, 480,483. M.L. p. 472,473,
(ah) (ai) (aj) (ak) (al)	Visual Alignment The Sweep Generator Oscilloscope Setting up Ratio Detector type - IF Ali	.gnment	475,476 M.L. p.476 M.L. p.476,477 M.L. p.477,479 M.L. p.479,480 M.L. p.473,475,
(am)	Aligning the Multiplex Secti	on	483,484 M.L. 484
14.	Servicing Dead Receivers		
	Servicing Procedure Check for Visible Clues	Z&S Job 72	M.L. p.487,488 M.L. p.488,490, 502
(c)	Phone or Volume Control Test	General Servicing of receivers	M.L. p.490
(e)	Tuning Eye or A.V.C. Test Shock Tests Use of Signal Generator	I GCGTAGL2	M.L. p.490,491 M.L. p.491,492 M.L. p.492,498, 500,504
	Stage by Stage Check with sig Oscillator Mixer Checks	g. gen.	M.L. p.498 M.L. p.499

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Ва	sic Information	Operations & Projects	References
15.	Servicing Weak Receivers		
(a) (b) (c) (d) (e)	Analysis of Complaint Localizing fault to one stage Basic causes of weak receivers Gain measurements Checking for Misalignment	During the portion of this course it is advisable to have the students service radios with typical faults placed in the receivers.	M.L. p.510 M.L. p.511 M.L. p.512,513,511 M.L. p.516,517,518 M.L. p.520,521,522
16.	Hum Troubles		
(a) (b) (c) (d) (e) (f) (g) (h)	Analysis of Complaint Basic Causes of Hum Identification of Types of Hum Localization of Hum Hum in B Supply Hum due to Heater Cathode Leaka Induced Hum Other causes of Hum	Scrvicing	M.L. p.523 M.L. p.523 M.L. p.524 M.L. p.524 M.L. p.525,526,527 M.L. p.528 M.L. p.529 M.L. p.529 M.L. p.530,531, 533,534, 535,536
17.	Oscillation and Motorboating		
(a) (b) (c) (d) (e) (f) (g) (h)	Analysis of Complaint Compare Amplifier/Oscillator Oscillation in Screen Grid Circuits Trouble in Decoupling Circuits Trouble in Bypass Circuits Feedback due to lead dress and contacts Instability and Feedback Localizing Complaints	Servicing	M.L. p.538 M.L. p.538,539 M.L. 539,540 M.L. 541 M.L. p.541,542 M.L. p.543 M.L. p.543,544 M.L. p.545,546,
(i) (j)	Microphonic Components Shielding		M.L. p.547 M.L. p.548,549
18.	Noise and Interference		
(a) (b) (c)	Causes of Noise Noise Isolating Techniques Noise in Antenna and Ground System	Servicing	M.L. p.552 M.L. p.553 M.L. p.554,555
(b)	Noise within the Receiver		M.L. p.556,557, 558

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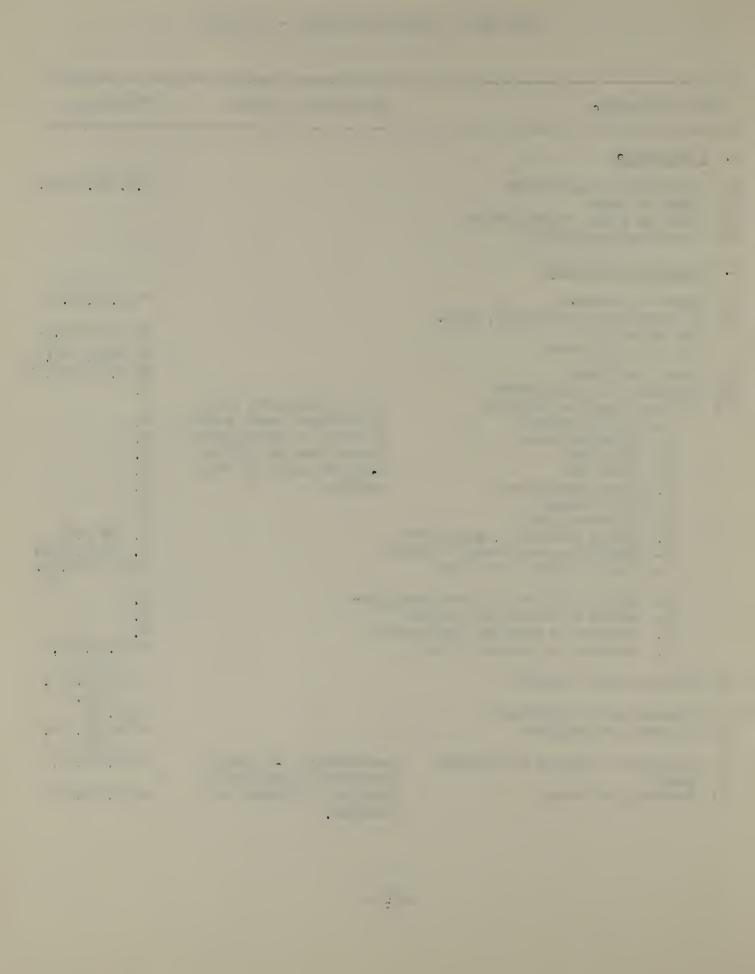
Ва	sic Information	Operations & Projects	References
(e) (f) (g) (h) (i) (j) (k)	Isolating Noisy Stage Locating Faulty Component Identifying External Noise Locating Source with a Portable Suppressing Commutator Noise Neon Sign and Lamp Noise Line Filters Intermittents		M.L. 559,560,561 M.L. p.562 M.L. p.563,564 M.L. P.568 M.L. p.571 M.L. p.572,573 M.L. p.575,576
(a) (b) (c) (d) (e) (f) (g) (h)	Analysis of Complaint Defects which can cause Intermittents Internal and External Causes Vacuum Tubes and Sockets Intermittents in Other Component Auto Radio Intermittents Intermittent Oscillators Techniques for Dealing with Int		M.L. p.580 M.L. p.580 M.L. p.581,582 M.L. P.582,583 M.L. p.583 M.L. p.584 M.L. p.584,586,586,587,588,589.
(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) 21.	Distortion Definition of Distortion Types of Distortion Causes of Distortion Grid Bias; Grid Emission Causes of Incorrect Bias Overloading Push-Pull Amplifiers and Phase Inverters Loudspeakers Localizing to Stage Isolating Faulty Components The Communications Receiver	Servicing	M.L. p.590,591, 592 M.L. p.592 M.L. p.592,594 M.L. p.592,595, 596 M.L. p.592,595 M.L. p.598 M.L. p.599,600 M.L. p.501,602 M.L. 606 M.L. 607
(a) (b)	General Tunable Front End	Z&S J•b 66	ARRL p.86-141 ARRL p.92,93. 165

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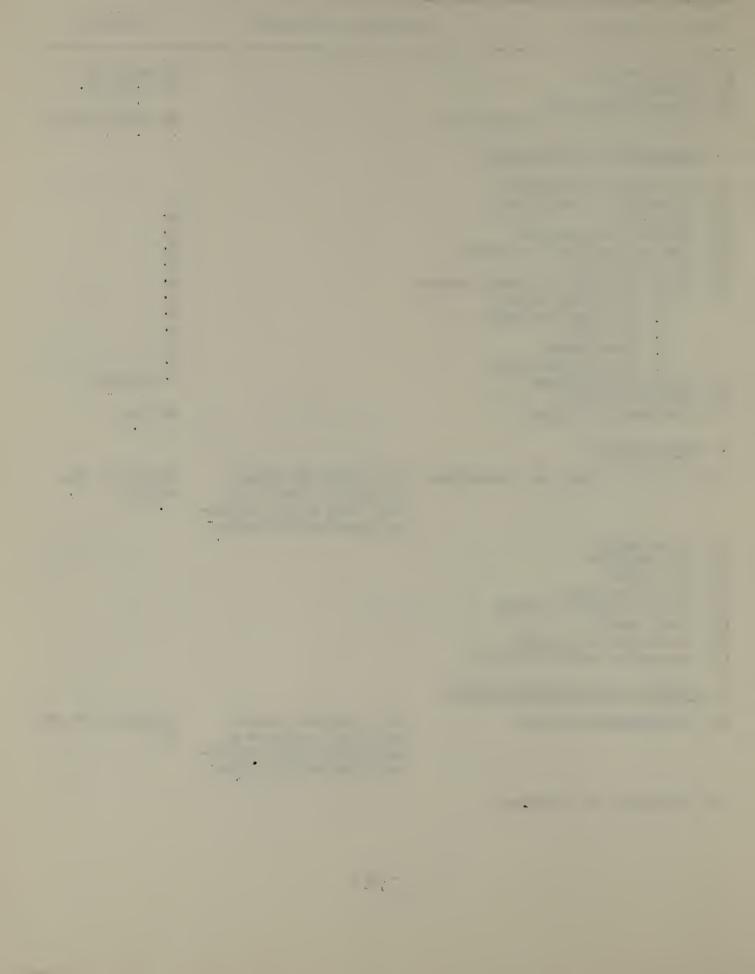
Ва	sic Information	Operations and Projects		References
(c) (d) (e)	Tunable IF Continuously Tunable Sensitivity 1. RF and IF Gain 2. Antenna Trimmer		N. ARRL	p.98,99 N. p.112,110 p.93
(f)	3. AVC and Delayed AVC Selectivity 1. Crystal Calibrators 2. Double and Triple Con 3. Bandspread Tuning 4. Filters and multiplie		ARRL ARRL ARRL ARRL	p.101 p.521 N. p.94,133, N. p.92 p.50,51,106 107,141
	Stability 1. Crystal and Permeabi Oscillators 2. Regulated Power Supp 3. Construction	·	ARRL N•	p.142,143,144
	Detectors 1. AM Detectors 2. CW and SSB Detectors 3. The BFO Noise Limiters		ARRL ARRL	p.86 to 90 p. 90,91 p.100,101 p.102,103,104
•	1. Squolch Circuits			p.102,103
(j) (k)	Carrier Level Indicators Audio Outputs 1. Loudspeaker 2. Headphones 3. Line		ARRL ARRL	p.104 p.105 p.105 N.
(1)	Quality of Components and Gen	eral Construction		p.167,169, N.

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Ва	sic Informati o n	Operations & Projects	References
(a) (b) (c) (d) (e) (f)	Introduction Transmitter requirements Types of waves Need for radio communications Licensing regulations Transmitter Circuits Types of emission LC Oscillators (review Tl, Secs. 5-1 to 5-8) Crystal Oscillators Power Oscillator RF Stages in transmitters RF Power Amplifier circuits 1. Classification 2. Operating Angle 3. Efficiency 4. Power Gain 5. Plate dissipation 6. Power Output 7. DC Power Input 8. Action of Class C. Amplifier 9. Distortion and Harmonic Cont 10. Class B. linear amplifier 11. Action of Class B. linear am 12. Action of the LC Tank circui 13. Design of a parallel tank ci	ent aplifier t	G.K. Ch.7,Sec.1 AR p.15,59,69 GK Ch.5,Sec.1- GK Ch.5, Sec.9 AR p.142,143,144 N. N. N. N. N. N. N. N. N.
(g)	14. Design of a pi-tank circuit Neutralization circuits		AR p.49,150, 162 AR p.151,158,
(h)	Neutralization procedures		159. AR p.403
(i)	Frequency multipliers		AR p.142,164,
(j)	Interstage coupling and driving power	Demonstration of tuning procedures desirable at	425 AR p.156,157
(k)	Metering and tuning	this point although not essential.	AR p.164,165



Basic Information	Operations & Projects	References	
(1) Keying methods (m) Parasitics		AR p.246 N. AR p.159,160	
(n) Transmitting tubes (o) Power Supplies for transmitters		AR p.209,231-241	
3. Modulation and Transmitters			
 (a) Principles of modulation (b) Percentage of modulation (c) Sidebands (d) Methods of modulation (e) High and Low level modulation (f) AM Transmitters (g) Single Sideband Suppressed Carri The filter system Balanced modulator The filter Heterodyning The phasing system (h) Frequency modulation (j) Frequency allocation 	er	N. AR p.331-426	
4. Power Supplies			
(a) Sources of power for transmitter	s The instructor should assign this section as home study with a follow-up classroom discussion.	Reading in GK, AR, RCA	
 (b) Transformers (c) The rectifier (d) The filter (e) Filter resonance (f) Filter component ratings (g) Power drain (h) Contactors and relays (i) Protective control circuits 	•		
5. Antennae and Transmission Lines			
(a) Electromagnetic waves	The instructor should assign this section as home study with a fellow-up classroom discussion	Reading in GK and AR	
(b) Principles of radiation			



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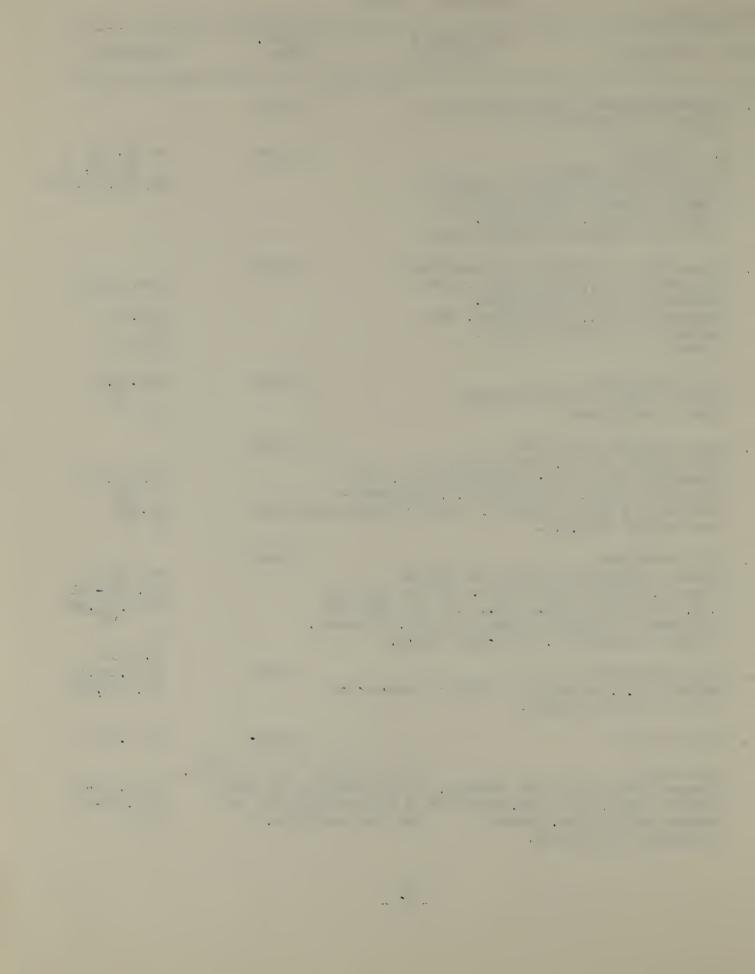
Operations and Projects

References

- Antenna requirements
- (d) The dipole antenna
- (e) Hertz and Marconi antennae
- (f) Antenna types
- (g) Directional arrays
- (h) Radio wave propagation
- Transmission lines
- (i) (j) Feeding and matching antennae



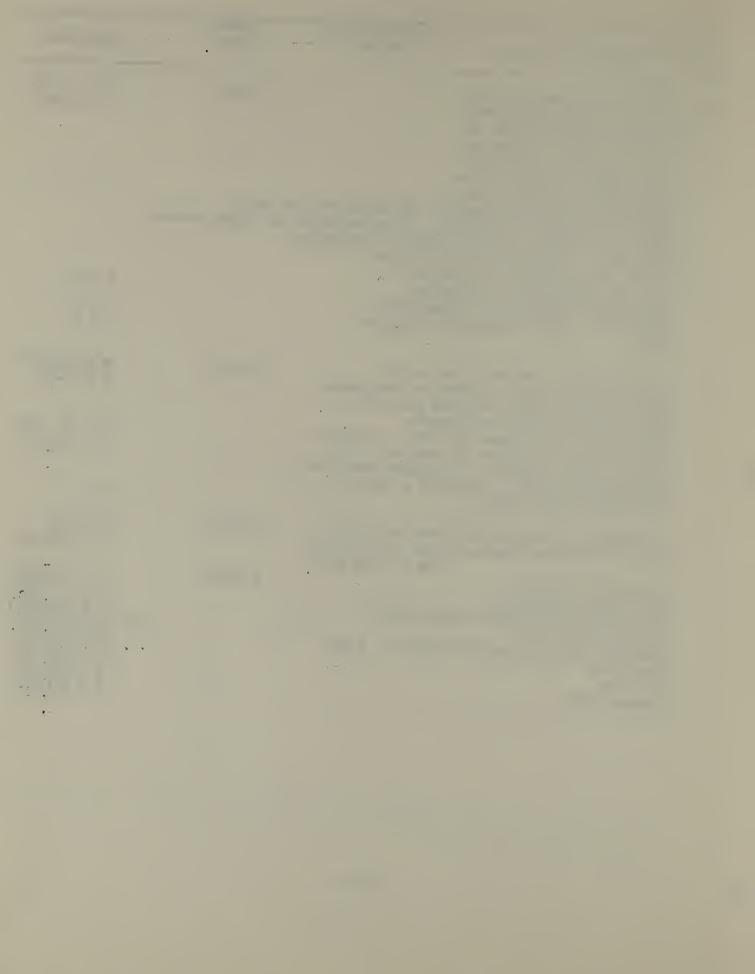
Ва	sic Information	Operations & Projects	Approx. Time	References
1.	ReviewSections 1 to METERS (Electronics 22		4 hours	
2.	A. C. Bridges General bridge equation Capacitance and induct bridges. Maxwell bridge of Maxwell bridge. Has Comparison of Maxwell	cance comparison dge, mathematics ay bridge.	5 hours	PP 72, 73, 74, 75, 77 USP. 125,126,128
3.	Measurement of Inducta Measurement of C., sub constant and frequency Measurement of L., sub constant and frequency Q meter.	ostitution, time remote methods. ostitution, time	5 hours	USP.124,128 USP.125 N 1 USP 140
4.	Test Oscillators Review of basic Oscill Types of oscillators	Lator thoery	2 hours	USP.94,95 96 N 1
5.	bridge oscillator. Co	Oscillators, se shift oscillator, we ommercial A.F. Generato circuit. Beat frequen	r -	PP. 259,263 110 PP. 263 N 1
6.	R. F. Generators - A.I	cillators. Various typ M., C.W., F.M. The grid f a commercial R.F. Gen	d dip	PP. 107 PP. 274-284 US P. 99,100 101 N 1.15.31
7.	Sweep Generators Review of F.M. Genera used in commercial un	tors. Study of sweep m its.	3 hours otor	US p.100,10° PP. 283,284
8.	Signal Tracers		2 hours	US P. 143
9•	Tube Testers Filament continuity, emission tests, gas t cathode leakage test. conductance measureme	short testing, this se ests, heater to as home Mutual the tim	Some or all of 4 hr ction may be given work depending on e available.	us P. 65-76 P P.288-300 N I



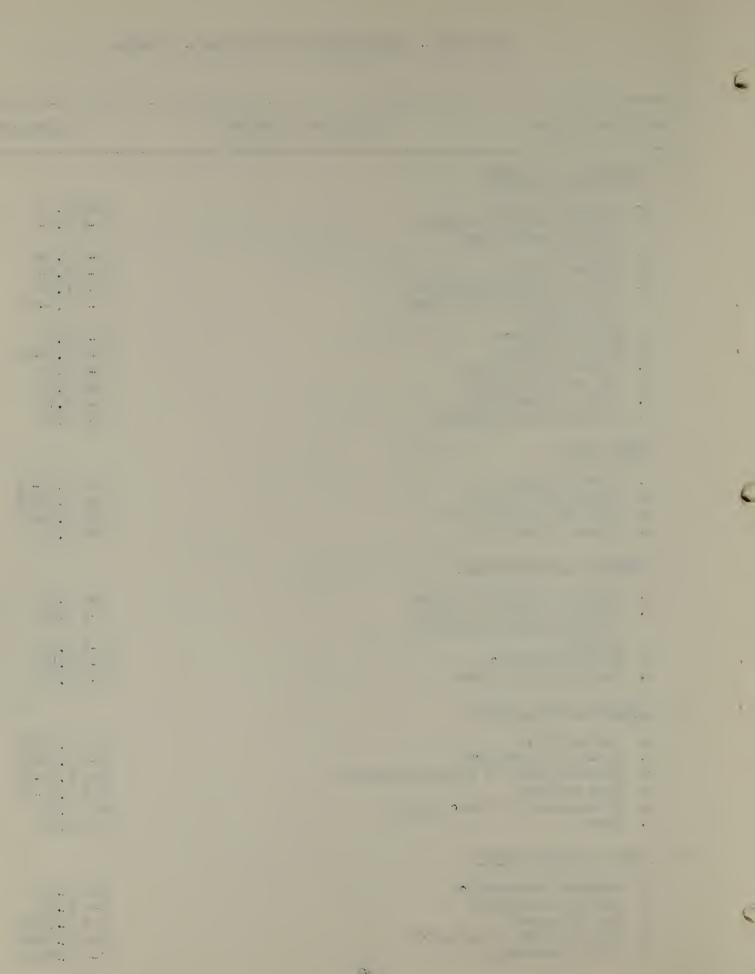
De	tailed Outline, Lectures	Operations and Projects	Approx. Time	References
10 0	Cathode Ray Tubes Electric fields, equipotential points and lines. The path of an electron moving through an electric field, fluorescence electrostatic focusing. Gun arrangement, optical analogy.		7 hours	U P 1 to 25 P P 215-221
	Brightness and focus controls. Intensifier anode, spot size, radius of curvature. Electros deflection. Deflection of an	electromagnetic anstatic deflection. electron		
	between charged parallel plate Angle of deflection. Deflecti	on		U P 26
	sensitivity. Position of defl plates in a C.R.T. Advantage sweep.			U P 27
17.,	Oscilloscopes. The basic scop time base generator. Relaxati Thyracron oscillator and sweep Other types of sweep oscillator	on oscillator. generator.	7 hours	p P 224,225 U P 66-75
	Synchronization of sweep circular amplifiers, requirements of vertical ampl. circuits. Parapush pull deflection. Study of	uits. Vertical ertical ampls. aphase amplifiers -		U P 76 - 84 U P 111-129
	commercial oscilloscope.	or a cyproar		NI
12.	Frequency and Phase Measuremer 'Scope' Lissajous figures, Pha		2 hours	P P 224 U P 195-199
13.		Method)	6 hours	P P 299,300, 301 P P 302,303, 306,307 (304 P P 307,310 P P 308,309 P P 310,311 P P 311,312

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В	asic Information	Operations & Projects	References
1.	The Television System		
	a. Picture Elements b. Transmitting & receiving		G-T P. 1 G-T P.2-6
	picture information. c. Scanning d. Motion Pictures e. Frame & Field Frequencies f. Vertical & horizontal scan	ı	G-T P.6-7 G-T P.7-8 G-T P.8-9 G-T P.9-10
	frequencies g. Synchronization h. Picture quality i. Television channels j. The FM sound system k. Color TV principle l. Transmission standards		G-T P.10 G-T P.10-12 G-T P.13 G-T P.14 G-T P.15
2,	Camera Tubes		
	a. Photoemissicnb. Flying spot camerac. Types of camera tubesd. Closed circuit TV		G-T P.18-21 G-T P.22-24 G-T P.24-35 G-T P.35
3.	Scanning & Synchronizing		
	a. Sawtooth waveform scanningb. Standard scanning pattern(include sample pattern)		G-T P.38 G-T P.40
	c. Flicker d. Raster Distortion e. Synchronizing pulses		G-T P.44 G-T P.45 G-T P.47
4.	Composite Video Signal		
	a. Construction b. Picture information c. Maximum number of picture d. Test pattern e. DC component of video sign f. Gamma		G-T P.52-57 G-T P.58-61 G-T P.62-64 G-T P.64-66 G-T P.66 G-T P.68
5.	Picture Carrier Signal		
	 a. Negative transmission b. Vestigial sideband c. The TV channel d. Line of sight transmission e. TV broadcasting 	1 - 140	G-T P.73 G-T P.74 G-T P.78-83 G-T P.83-86 G-T P.86-91



В	Basic Information	Operations and Projects	References
6,	Television Receiver a. Receiver circuit b. Sound takeoff c. Functions of rec d. Operating control e. Localizing troub	eiver circuits *(Note #1) ls	G-T P. 94-1 G-T P. 99 G-T P. 101 G-T P.103-104 G-T P.112-115

^{*} NOTE # 1 - Laboratory experiments 1, 2 & 3, <u>Basic Television</u> by Zbar and Schildkraut should be carried out mainly with the intent of <u>teaching familiarization</u> and proper safety procedures. The instructor may cover more experiments; however, this will be determined by the time and equipment that is available.

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